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THE DETECTION OF A 3.486 HOUR PHOTOMETRIC PERIOD IN THE CLASSICAL NOVA V2468 CYGNI

CHOCHOL, D.[1]; SHUGAROV, S.Y.[1,2]; VOLKOV, I.M.[1,2]; GORANSKIJ, V.P.[2]; METLOVA, N.V.[2]; BARSUKOVA, E.A.[3]; GABDEEV, M.M.[3]

[1] Astronomical Institute of the Slovak Academy of Sciences, 059 60 Tatranská Lomnica, Slovakia, e-mail: chochol@ta3.sk

[2] Sternberg Astronomical Institute, Universitetski prospect 13, Moscow, 119992 Russia

[3] Special Astrophysical Observatory of the Russian Academy of Sciences, Nizhniy Arkhyz, Karachai-Cherkesia, 369167 Russia

Classical nova V2468 Cyg (Nova Cygni 2008) was discovered by H. Kaneda on March 7.801 UT (JD 2454534.301) at $8^{m}_{.}2$ at the coordinates α_{2000} $=19^{h}58^{m}33^{s}_{.}39$, $\delta_{2000} = +29^{\circ}52'06''_{.}5$, measured by K. Kadota on the CCD image taken on March 8.716 UT (Nakano, 2008). It was classified as a Williams Fe II class nova (Beaky, 2008); Henden and Munari (2008) found a faint star USNO-B1 1198-0459968 ($R = 18$ mag) close to the position, visible only on POSS-II red plates, not on the blue ones. The amplitude of the outburst was larger than 12 mag in the B band. The nova entered to a nebular stage 122 days after the outburst (Iijima & Naito, 2011). The supersoft X-ray source (SSS) stage of the nova started in June 2009 ($\sim$460 days after outburst) when the object was detected by Swift with the XRT and UVOT instruments. The X-ray light curve was variable with a large amplitude on time scale of 500 seconds, UV observations showed large amplitude variations of the order 0.3 mag (Schwarz et al., 2009). In July 2012 (1602 days after outburst) the X-ray flux of the nova strongly increased (Page et al., 2012). At that time, the duration of the SSS stage already exceeded 3 years.

Chochol et al. (2012) used the B and V photometric light curves to find the rates of decline $t_{2,V} = 9$, $t_{2,B} = 10$, $t_{3,V} = 20$ and $t_{3,B} = 22$ days of this fast nova. They determined its basic parameters: $M_{V,\max}$ = -8.70± 0.07, interstellar extinction $E(B-V) = 0.79\pm0.01$ and distance $d = 5.4\pm0.6$ kpc.

In 2011 and 2012 we monitored V2468 Cyg in the V passband, with the time resolution from one to two minutes, using the 0.5 m and 0.6 m telescopes of the Stará Lesná observatory (Slovakia), 0.6 m and 1.25 m telescopes at the Crimean Laboratory of the Sternberg Institute in Nauchnyj (Ukraine), 0.6 m and 1 m Zeiss telescopes at Simeiz Observatory at Mt. Koshka (Ukraine), and 1 m Zeiss SAO RAS telescope of the Special Astrophysical Observatory in Nizhniy Arkhyz (Karachai-Cherkesia, Russia).

Our V light curve, presented in Fig. 1, shows a large variability due to the presence of quasi-periodic oscillations (QPO) with periods in the range 21 - 50 minutes and amplitudes up to 0.5 mag (for details see Chochol et al., 2012), combined with strictly periodic light variations with the amplitude (0.08 - 0.15) mag and the stable period of 3.486 hours. The QPO either disappeared or their amplitudes were very small after the increase of X-ray brightness in July 2012.

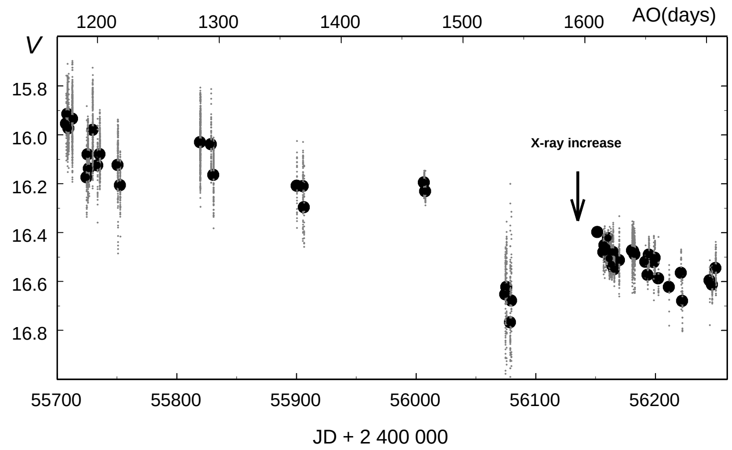

Figure 1. V light curve of V2468 Cyg in 2011-12 during the decline from the outburst.

The long night runs with the QPO and without QPO are shown in Fig. 2 and Fig. 3, respectively. Due to the fact that different telescopes and CCD cameras were used, we were forced to use different check stars, to demonstrate their brightness stability.

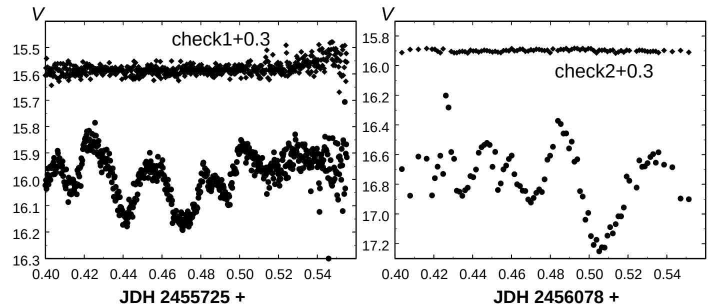

Figure 2. The nightly runs with QPO.

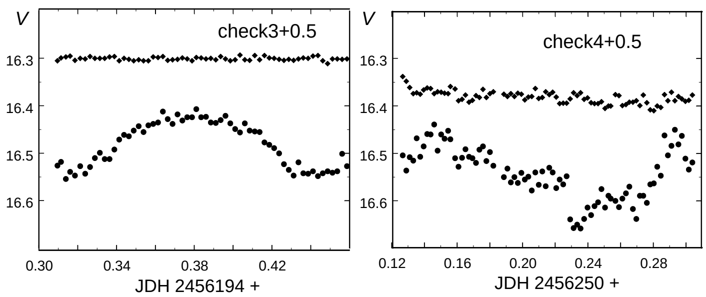

Figure 3. The nightly runs without QPO.

The best period was found by Fourier analysis of the data in nights JD 2456006-007, JD 2456156-250 (see Fig. 4). We determined the following ephemeris for the minima of brightness:

$$\mathrm{Min} = JD2456006.355 + 0\overset{\mathrm{d}}{.}145250(5)\ \times\ E.$$

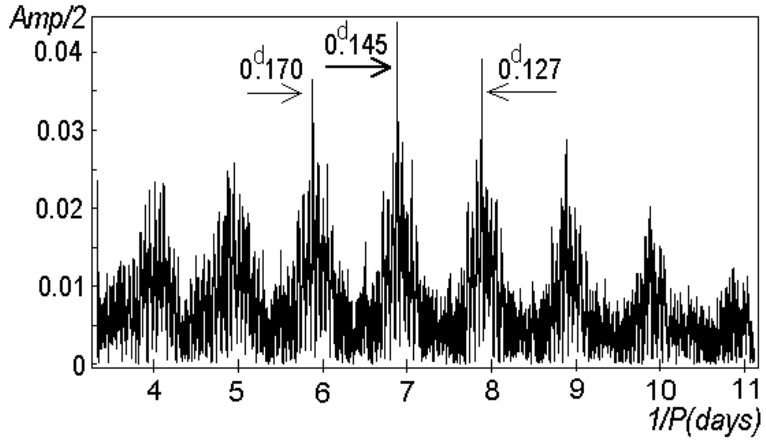

Figure 4. The best period $0^{\mathrm{d}}\!.145250$ ($3^{\mathrm{h}}\!.486$) and its one day aliases found by the Fourier analysis.

The phase light curve corresponding to these data is presented in Fig. 5.

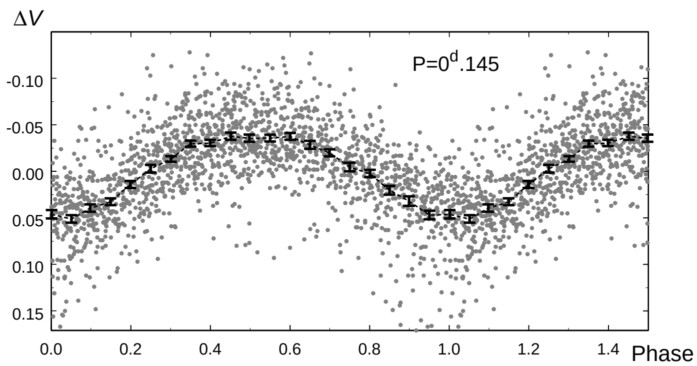

Figure 5. The *V* phase light curve of V2468 Cyg in 2012, corresponding to our ephemeris.

The nature of SSSs in classical novae is explained with the steady thermonuclear burning on the surface of a white dwarf with high accretion rate (Kahabka & van den Heuvel, 1997). The light variations are most probably caused by orbital motion in the binary system and irradiation of the secondary star by the hot white dwarf. The rotation of the magnetic white dwarf with the magnetic axis inclined to the rotational axis can explain the periodic variations, too. In such a case a thermonuclear burning runs nearby the magnetic pole of the white dwarf.

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